

Water Pollution

The Water (Prevention and Control of Pollution) Act was enacted in 1974 to provide for the prevention and control of water pollution, and for the maintaining or restoring of wholesomeness of water in the country. The Act was amended in 1988.

Parcham Classes

India's Water (Prevention
and Control of Pollution)
Act, 1974



- Water pollution is the addition/presence of undesirable substances to/in water such as organic, inorganic, biological, radiological, heat, which degrades the quality of water so that it becomes unfit for use'.
- Natural sources of pollution of water are soil erosion, leaching of minerals from rocks (due to natural solubility and solubility triggered by acid rain) and decaying of organic matter.
- Point and non-point sources of pollution
- When pollutants are discharged from a specific location such as a drain pipe carrying industrial effluents discharged directly into a water body it represents point source pollution.
- In contrast, non-point sources include discharge of pollutants from diffused sources or from a larger area such as runoff from agricultural fields, grazing lands, construction sites, abandoned mines and pits, etc.

Causes of Water Pollution

- **Dissolved Oxygen (DO)**
 - Presence of organic and inorganic wastes in water decreases the dissolved oxygen content of the water.
 - Water having DO content below 8.0 mg/L may be considered as contaminated.
 - Water having DO content below 4.0 mg/L is considered to be highly polluted.
 - DO content of water is important for the survival of aquatic organisms.
 - A number of factors like surface turbulence, photosynthetic activity, O₂ consumption by organisms and decomposition of organic matter are the factors which determine the amount of DO present in water.
 - The higher amounts of waste increase the rates of decomposition and O₂ consumption thereby decreases the DO content of water.
- **Biological Oxygen Demand (BOD)**
 - Water pollution by organic wastes is measured in terms of Biochemical Oxygen Demand (BOD).
 - BOD is the amount of dissolved oxygen needed by bacteria in decomposing the organic wastes present in water. It is expressed in milligrams of oxygen per litre of water.
 - The higher value of BOD indicates low DO content of water.
 - Since BOD is limited to biodegradable materials, it is not a reliable method of measuring water pollution.
- **Chemical oxygen demand (COD)**
 - Chemical oxygen demand (COD) is a slightly better mode used to measure pollution load in the water.
 - COD measures the amount of oxygen in parts per million required to oxidise organic (biodegradable and non-biodegradable) and oxidizable inorganic compounds in the water sample.
- **Sewage Water**
 - Sewage water includes discharges from houses and other establishments.
 - The sewage contains human and animal excreta, food residues, cleaning agents, detergents, etc.
 - Domestic and hospital sewage contain many undesirable pathogenic microorganisms.
- **Industrial Wastes**
 - Discharge of wastewater from industries like petroleum, paper manufacturing, metal extraction and processing, chemical manufacturing, etc., that often contain toxic substances, notably, heavy metals (defined as elements with density > 5 g/cm³ such as mercury, cadmium, copper, lead, arsenic) and a variety of organic compounds.
- **Agricultural sources**
 - Agricultural runoff contains dissolved salts such as nitrates, phosphates, ammonia and other nutrients, and toxic metal ions and organic compounds.
 - Fertilizers contain major plant nutrients such as nitrogen, phosphorus and potassium.
 - Excess fertilisers may reach the groundwater by leaching or may be mixed with surface water.
 - Pesticides include insecticides, fungicides, herbicides, etc. They contain a wide range of chemicals such as chlorinated hydrocarbons (CHCs. E.g. DDT, Endosulfan etc.)
 - Many of the pesticides are non-degradable, and their residues have a long life.

Thermal and Radiation Pollution

- **Power plants** – thermal and nuclear, chemical and other industries use a lot of water for cooling purposes, and the used hot water is discharged into rivers, streams or oceans.
- Discharge of hot water may increase the temperature of the receiving water by 10 to 15 °C above the ambient water temperature. This is thermal pollution.
- Increase in water temperature decreases dissolved oxygen in the water.
- Unlike terrestrial organisms, aquatic organisms are adapted to a uniform steady temperature of the environment. A sudden rise in temperature kills fishes and other aquatic animals.
- One of the best methods of reducing thermal pollution is to store the hot water in cooling ponds, allow the water to cool before releasing into any receiving water body
- Nuclear accidents near water bodies or during natural calamities like tsunami and earthquakes pose the risk of radiation leakage (radiation exposure) into water bodies. E.g. **Fukushima Daiichi nuclear disaster**.
- Radiation exposure causes mutations in the DNA of marine organisms. If those mutations are not repaired, the cell may turn cancerous.
- Radioactive iodine tends to be absorbed by the thyroid gland and can cause thyroid cancer.

Marine pollution

- Oceans are the ultimate sink of all natural and manmade pollutants.
- The sewerage and garbage of coastal cities are also dumped into the sea.
- The other sources of oceanic pollution are navigational discharge of oil, grease, detergents, sewage, garbage and radioactive wastes, offshore oil mining, oil spills.
- Oil Spills
- The most common cause of oil spill is leakage during marine transport and leakage from underground storage tanks.
- An oil spill could occur during offshore oil production as well.
- Impact of oil spill on marine life
- Oil being lighter than water covers the water surface as a thin film cutting off oxygen to floating plants and other producers.
- Within hours of an oil spill, the fishes, shellfish, plankton die due to suffocation and metabolic disorders.
- Birds and sea mammals that consume dead fishes and plankton die due to poisoning.

Invasive species

- Plants of water hyacinth are the world's most problematic aquatic weed, also called 'Terror of Bengal'.
- They grow abundantly in eutrophic water bodies and lead to an imbalance in the ecosystem.



Underground water pollution

- In India at many places, the groundwater is threatened with contamination due to seepage from industrial and municipal wastes and effluents, sewage channels and agricultural runoff.
- Pollutants like fluorides, uranium, heavy metals and nutrients like nitrates and phosphates are common in many parts of India.
- **Nitrates**
- Dissolved nitrates commonly contaminate groundwater.
- Excess nitrate in drinking water reacts with haemoglobin to form non-functional methaemoglobin and impairs oxygen transport. **This condition is called methemoglobinemia or blue baby syndrome.**
- High level of nitrates may form carcinogens and can accelerate eutrophication in surface waters.
- **Trace metals**
- Include lead, mercury, cadmium, copper, chromium and nickel.
- These metals can be toxic and carcinogenic.
- **Arsenic**
- Seepage of industrial and mine discharges, fly ash ponds of thermal power plants can lead to arsenic in groundwater.
- In India and Bangladesh (Ganges Delta), millions of people are exposed to groundwater contaminated with high levels of arsenic, a highly toxic and dangerous pollutant.
- **Chronic exposure to arsenic causes black foot disease. It also causes diarrhoea and also lung and skin cancer.**
- **Fluoride**
- Excess fluoride in drinking water causes neuromuscular disorders, gastrointestinal problems, teeth deformity, hardening of bones and stiff and painful joints (skeletal fluorosis).
- **Pain in bones and joint and outward bending of legs from the knees is called Knock-Knee syndrome.**
- Fluorosis is a common problem in several states of the country due to the intake of high fluoride content water.

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Q1. Which of the following can be found as pollutants in the drinking water in some parts of India?

1. Arsenic
2. Sorbitol
3. Fluoride
4. Formaldehyde
5. Uranium

Select the correct answer using the codes given below.

1 and 3 only

2, 4 and 5 only

1, 3 and 5 only

1, 2, 3, 4 and 5

Ans:c



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Effects of Water Pollution on Human Health

- Domestic and hospital sewage contain many undesirable pathogenic microorganisms, and its disposal into water without proper treatment may cause an outbreak of serious diseases, such as typhoid, cholera, etc.
- Metals like lead, zinc, arsenic, copper, mercury and cadmium in industrial wastewaters adversely affect humans and other animals.
- Consumption of such arsenic polluted water leads to accumulation of arsenic in the body parts like blood, nails and hairs causing skin lesions, rough skin, dry and thickening of the skin and ultimately skin cancer.
- Mercury compounds in wastewater are converted by bacterial action into extremely **toxic methyl mercury, which can cause numbness of limbs, lips and tongue, deafness, blurring of vision and mental derangement.**
- Pollution of water bodies by mercury causes Minamata (neurological syndrome) disease in humans.
- Lead causes lead poisoning (Lead interferes with a variety of body processes and is toxic to many organs and tissues).
- The compounds of lead cause anaemia, headache, loss of muscle power and bluish line around the gum.
- Water contaminated with cadmium can **cause itai itai disease** also called ouch-ouch disease (a painful disease of bones and joints) and cancer of lungs and liver.

Effects of Water Pollution on the Environment

- Micro-organisms involved in biodegradation of organic matter in sewage waste consume a lot of oxygen and make water oxygen deficient killing fish and other aquatic creatures.
- Presence of large amounts of nutrients in water results in algal bloom (excessive growth of planktonic algae. This leads to ageing of lakes.
- High concentrations of DDT disturb calcium metabolism in birds, which causes thinning of eggshell and their premature breaking, eventually causing a decline in bird populations.

Eutrophication

- Lakes receive their water from surface runoff and along with its various chemical substances and minerals.
- Over periods spanning millennia, ageing occurs as the lakes accumulate mineral and organic matter and gradually, get filled up.
- The nutrient-enrichment of the lakes promotes the growth of algae, aquatic plants and various fauna. This process is known as natural eutrophication.
- Similar nutrient enrichment of lakes at an accelerated rate is caused by human activities and the consequent ageing phenomenon is known as cultural eutrophication.
- On the basis of their nutrient content, lakes are categorized as Oligotrophic (very low nutrients), Mesotrophic (moderate nutrients) and Eutrophic (highly nutrient rich).
- A vast majority of lakes in India are either eutrophic or mesotrophic because of the nutrients derived from their surroundings or organic wastes entering them.

Eutrophication and Algal Bloom

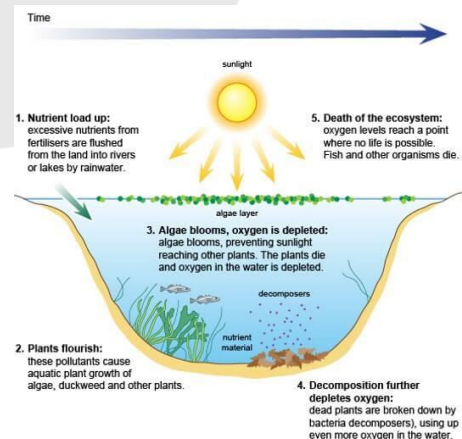
- Eutrophic water body: it is a body of water rich in nutrients and so supporting a dense plant population, the decomposition of which kills animal life by depriving it of oxygen.
- Eutrophication is the response to the addition of nutrients such as nitrates and phosphates naturally or artificially, fertilising the aquatic ecosystem.
- Phytoplankton (algae and blue-green bacteria) thrive on the excess nutrients and their population explosion covers almost entire surface layer. This condition is known as algal bloom.



Mechanism

- Phytoplankton are photosynthetic during day time adding oxygen to the aquatic ecosystem.
- But during nights, they consume far more oxygen as they respire aggressively.
- i.e. Algal blooms accentuate the rate of oxygen depletion as the population of phytoplankton is very high.
- The primary consumers like small fish are killed due to oxygen deprivation caused by algal blooms.
- Death of primary consumers adversely affects the food chain.
- Further, more oxygen is taken up by microorganisms during the decomposition process of dead algae, plants and fishes.
- The new anaerobic conditions (absence of oxygen) created to promote the growth of bacteria such as *Clostridium botulinum* which produces toxins deadly to aquatic organisms, birds and mammals.

- Water temperature has also been related to the occurrence of algal blooms, with unusually warm water being conducive to blooms.
- Algal blooms can be any colours, but the most common ones are red or brown. These blooms are commonly referred to as red or brown tides.



1. The increase in concentration of which gas is not responsible for Global Warming?

- (a) Sulphur dioxide
- (b) Nitrogen
- (c) Carbon dioxide
- (d) Methane

2. Which element is present in the exhaust of automobiles?

- (a) Lead
- (b) Calcium
- (c) Chromium
- (d) Magnesium

3. In which year Ganga Action Plan was launched?

- (a) 1980
- (b) 1984
- (c) 1982
- (d) 1985

4. The phenomenon of marble cancer is due to

- (a) soil particles
- (b) fog
- (c) CFCs
- (d) acid rain

5. The solid or liquid particles dispersed in the air are called

- (a) oxides
- (b) acids
- (c) hydrocarbons
- (d) Aerosols

6. The major causes of air pollution include

- (a) burning of coal and petroleum
- (b) afforestation
- (c) deforestation
- (d) recycling of paper

7. Bhopal tragedy was caused due to

- (a) air pollution
- (b) emission of poisonous gas
- (c) water pollution
- (d) leakage of poisonous gas

The Bhopal disaster occurred when about 45 tons of the gas methyl isocyanate escaped from a plant owned by a subsidiary of the U.S.-based Union Carbide Corporation.

8. Which of the following contents is most harmful to aquatic animals?

- (a) Heavy metal ions
- (b) Sodium ions
- (c) Potassium ions
- (d) Chloride ions

9. Which of the following is a non-biodegradable pollutant?

- (a) Sulphur dioxide
- (b) DDT
- (c) Nitrogen oxide
- (d) Hydrogen oxide

10. Which of the following techniques of irrigation should be used to save water?

- (a) Water wheel
- (b) Canal irrigation
- (c) Drip irrigation
- (d) Lift irrigation

11. Smog =

- (a) Smoke in dog's stomach
- (b) Smoke + fog
- (c) Smoke dog
- (d) frog in fog

12. The gas used in refrigerating appliance causing serious damage to ozone is

- (a) MFCs
- (b) CFCs
- (c) LPCs
- (d) DPCs

13. Acid rain mainly contains

- (a) Sodium chloride
- (b) Sulphur dioxide and Nitrogen dioxide
- (c) Hydrochloric acid
- (d) Carbon tetra chloride

14. Greenhouse gases includes

- (a) CO₂, Methane, Nitrous oxide
- (b) CO₂, Argon, Nitrous oxide
- (c) CO₂, Methane, Chlorine
- (d) CO₂, Methane, Flourine

15. Van Mahotsav is

- (a) Planting trees in January
- (b) Cutting trees in January
- (c) Cutting trees in July
- (d) Planting trees in July

Answers

- | | |
|----------|-----------|
| 1. Ans:b | 9. Ans:b |
| 2. Ans:a | 10. Ans:c |
| 3. Ans:d | 11. Ans:b |
| 4. Ans:d | 12. Ans:b |
| 5. Ans:d | 13. Ans:b |
| 6. Ans:a | 14. Ans:a |
| 7. Ans:d | 15. Ans:d |
| 8. Ans:a | |